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**A SUMMARY OF THE LIFE HISTORY OF THE COMMON
SHRIMP (*PENAEUS SETIFERUS*) OF THE SOUTH
ATLANTIC AND GULF COASTS OF THE
UNITED STATES***

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The shrimp fishery since 1880 has been marked by a phenomenal increase in catch, doubling itself every eight or nine years, until in 1928 over 118 million pounds were taken in the United States. Since 1928, as a result of the economic conditions, the catch has fallen off somewhat. Of all the fisheries of the United States including Alaska, the shrimp in 1929 with a take of 113,263,000 pounds ranked ninth in volume and fifth in value. The value to the fishermen was \$4,575,000.00. In this year (1929), 95% of the catch was produced by the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas. Louisiana alone yielded 43%, consequently making her by far the largest shrimp yielding state in the Union.

This important fishery of the South Atlantic and Gulf States is dependent upon three species of shrimp, *Penaeus setiferus*, *Penaeus brasiliensis* and *Xiphopenaeus kroyeri*, of the family *Penaeidae*. The Common shrimp (*Penaeus setiferus*) is the basis for about 95% of the fishery, while the grooved shrimp (*Penaeus brasiliensis*) and the sea bob (*Xiphopenaeus kroyeri*) together yield about 5%. In 1929, the take of *Penaeus setiferus* comprised about 100,000,000 pounds.

The data upon which this summary of the life history is based are too voluminous to reproduce here, since they consist almost wholly of total length measurements with observations on the state of development of the gonads of over 100,000 individual shrimp. Most of the conclusions here presented are based upon the Georgia data, since these data extend over the greatest period of time (October, 1930, to August, 1932) and are less fragmentary. Although, with

*The Shrimp Investigations inaugurated by the Bureau of Fisheries in 1931 are being conducted with the co-operation of the Louisiana Department of Conservation, the Georgia Department of Game and Fish, and the Texas Game, Fish and Oyster Commission. Field stations and laboratories are located at Beauford, North Carolina; Brunswick, Georgia; New Orleans, Louisiana, and Aransas Pass, Texas.

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but few variations, the same explanations will hold for Louisiana and Texas.

From the interpretation of the data it is evident that spawning begins in March or April, depending upon seasonal conditions, and continues until August or September. Judging from the localities in which ripe individuals are found and from the localities in which spermatophore-bearing females are taken, it is most probable that spawning occurs in the open ocean or Gulf where the salinity is high.

The extensive plankton collections of the investigations have not, as yet, been studied in detail. As a result we are unable at this date to state anything definite concerning the larval stages. However, as shown by Müller, Brooks and Kishinouye the larvae of the *Penaeidae* hatch as nauplii and pass through several stages (7 to 9) including the zoea and mysis.

Nevertheless, the young post-larval stages ranging from 7 to 40 mm. have been seined in great abundance in the four states in which the investigations are in progress. These young are found on the inside in warm, shallow, brackish waters having mud bottoms. The young have been obtained in Louisiana as far inland as forty miles from the coast in waters with a salinity of only two or three parts per thousand. Apparently they move to the inside waters after having passed the larval period in the more saline waters of the open sea or gulf. They are first evident in April and May—grow rapidly and appear in the commercial catch in July at an average size of about 93 mm. By August they have increased to an average size of about 125 mm. During this period of rapid growth the young shrimp double their weight in nearly three weeks.

At the onset of cold weather in the fall, the growth apparently ceases or, at least, increases only slightly and the shrimp winter-over at an average size of about 135 mm. But with the coming of the warmer weather in the spring, there occur sudden changes in the shrimp population. The gonads mature rapidly, with spawning taking place within three weeks after the first appearance of the developing ovaries. A rapid sexual dimorphism takes place with the females soon outstripped the males in size until by June the females average 156 mm. while the males average only 144 mm., a difference of 8%.

At this time there is also an interesting change in the size-range of the shrimp. During the spring in each sex a distribution of wide range without a sharp mode is converted into a compact group with little variation of size and a well marked mode. This may be due to either the more rapid growth of the smaller and younger members or the disappearance of the larger spent individuals, or a combination of both.

That climatic and hydrographic conditions are large factors in the movements of the shrimp is evidenced by the fact that in Barataria bay, Louisiana, in the late summer and fall of 1931 there was a

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high negative correlation ($r = -.7675 \pm .07007$) between the changes in the average weekly air temperature and the changes in the average weekly per cent of females. In other words, when the air temperature was lower in one week than in the preceding week there occurred a greater proportion of females in the commercial catch. Likewise, an increase in temperature was associated with a decrease in the per cent of females. The males, necessarily, followed inversely.

During this same period there was also a high positive correlation ($r = +.5151$) between the average weekly temperatures and weekly average length of the females—the females in the commercial catch were larger on warmer weeks.

These findings are based upon the individual measurements of over 35,000 shrimp covering a period of fourteen weeks (August 17th to November 20th). The number of shrimp measured for any week never fell below 1,000 and many were over 3,000.

As the shrimp spawn they apparently die, at least no spent shrimp have ever been taken. Among the 18,487 female shrimp measured during the spawning seasons of 1931 and 1932, there were none that were in a spent condition. Another striking bit of evidence that points toward the death of the shrimp after spawning is the fact that after the appearance of the young shrimp-of-the-year in the commercial catch during July, which is near the end of the spawning season, the large mature shrimp rapidly disappear and after October no trace of them can again be found.

This being the case, the Common Shrimp differs decidedly from any other aquatic animal supporting a major fishery in that it has a life cycle of only one year. The entire catch (100,000,000 pounds in 1929) is composed of individuals that have not had and never will have an opportunity to spawn. As a result, if depletion ever sets in it is likely to run a rapid and disastrously precipitous course. Luckily, at present, no serious depletion is evident. We have found that the catch statistics kept by the various South Atlantic and Gulf states are quite inadequate for any analysis of abundance of the shrimp. However, steps are now being taken by Louisiana and Texas to provide adequate statistics, based upon the California system, so that when depletion occurs it can be detected, and protective legislation, based upon the fundamental biology of the shrimp, can be enacted.